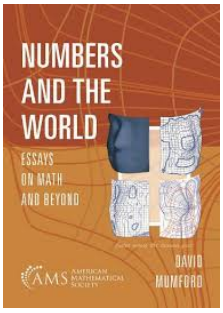
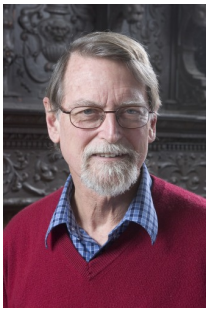
Numbers and the world. Essays on math and beyond *David Mumford*. AMS, 2023 (xvi+241 p.), isbn: 978-1-4704-7051-7 (pbk)





David Mumford

David Mumford is an American polymath, born in the UK, winner of the Fields Medal (1974), and of many other prizes, among which the Shaw Prize (2006), Steel Prize (2007), the Wolf Prize (2008), and the National Medal of Science (2010). He worked in algebraic geometry and later in computer vision and pattern theory. With this book (at the time of writing it in 2023 he is 85) he gives, as a round-up of his very productive life and his quite diverse interests, his vision on a number of scientific, social, and political issues. There are 19 chapters grouped into four parts. It would be impossible to give in this review a reasonable insight on the contents of each of the chapters. So here is a quick survey.

Part 1 (3 chapters) is about education and popularization of mathematics. There is of course the widespread disdain for mathematics. His answer is to teach students the applications first, let them solve meaningful real life problems, the abstraction comes later. As an admirer of Grothendieck, he wrote an obituary trying to explain his work to the non-mathematician. The remaining chapter is remarkable. When asked to select "the most beautiful mathematical formula" he starts by dividing the mathematicians into 4 different "tribes" since each will differ about the beauty of a formula. There are the *explorers* (subdivided into *mappers* and *gem-collectors*) looking for objects with certain properties; the *alchimists* who want to connect remotely different subjects; the *wrestlers* who are interested in inequalities, measuring the relative strength of both sides; the *detectives* (subdivided into *miners* and *baptizers*) who try to solve the most difficult and challenging problems. He gives examples of historical mathematicians and what kind of formulas they would select from a top 100 formulas. His analysis is quite accurate.

Part 2 (4 chapters) is about the history of mathematics. The first is about the Pythagoras theorem, raising the question why it was discovered independently in several cultures long before Pythagoras. The next two are about the history of algebra and how the different branches of mathematics were added in the course of history and how they are related. In the fourth he draws a parallel between the developments in mathematics and in art in the last two centuries.

Part 2 (3 chapters) deals with AI, neuroscience and consciousness. The original research was based on grammar and parse trees, but that changed with the introduction of neural nets in an attempt to mimic the working of our brain. He was not an early adaptor of these deep learning techniques and claims that there is some map of the parse tree present in the brain. New to the field, and currently a hot scientific topic is the question whether robots (or animals) can ever be conscious like we humans are? Some animals seem to have some form of it, but whether robots will ever be conscious is yet to be found out. Even clear definitions of our moods and feelings need to be agreed upon.

Part 4 (3 chapters) describes 3 of his pet topics: some result about the smallest zero of the Riemann-zeta function; an analysis of rogue waves; and an alternative for the ZFC foundation of mathematics based on reverse mathematics (i.e., find the minimal foundations needed). In his opinion, applied math did not play the role it should.

Part 5 (2 chapters) is about quantum theory. He explains his thoughts about the quantum collapse, and his ideas about quantum computing.

Part 6 (4 chapters) deals with miscellaneous personal topics: the publishing crisis that evolved from small publishers to the dominant Elseviers and Springers of this world just wanting to make profit; how politics and religion can interfere with mathematics; his predictions of the world for the next decennia.

Each chapter has some fresh and original ideas from a great mathematician. I certainly enjoyed reading each of them.

Adhemar Bultheel